

CLAIMS

1. A galvannealed steel sheet excellent in the coating adhesion characterized in that in an interface between a galvannealed layer and a base steel sheet on which the galvannealed layer is formed, an irregularity that has a depth of 10 nm or more at a pitch of 0.5 μm or less is present at least one per 5 μm of a length of the interface.

2. A galvannealed steel sheet excellent in the coating adhesion characterized in that a surface shape of a base steel sheet that is observed after a galvannealed layer is peeled has a developed interfacial area ratio S_{dr} measured by use of a high-pass filter with a cut-off wavelength of 0.5 μm of 2.0 percent or more.

3. The galvannealed steel sheet excellent in the coating adhesion according to claim 1 or 2 characterized in that the base steel sheet contains, by mass percent, 0.25 percent or less of C, 0.03 to 2.0 percent of Si and 0.005 to 0.07 percent of P and has a composition satisfying the following equation (1).

Note

$$[\text{C}] + [\text{P}] \leq [\text{Si}] \quad (1)$$

Here, $[\text{C}]$, $[\text{P}]$ and $[\text{Si}]$, respectively, mean contents (mass percent) of C, P and Si in the base steel sheet.

4. The galvannealed steel sheet excellent in the coating adhesion according to claim 3 characterized in that in a stage

immediately before a coating layer is adhered to the base steel sheet, in order that Si contained in the base steel sheet is not selectively oxidized on a surface, the base steel sheet is heat treated before the coating layer is adhered.

5. The galvannealed steel sheet excellent in the coating adhesion according to claim 3 or 4 characterized in that in a base steel immediate below the interface an oxide of silicon is contained.

6. The galvannealed steel sheet excellent in the coating adhesion according to claim 3, 4 or 5 characterized in that the base steel sheet has a composition that further includes, by mass percent, 5 percent or less of Mn, 0.01 percent or less of S and 0.08 percent or less of Al.

7. The galvannealed steel sheet excellent in the coating adhesion according to any one of claims 3 through 6 characterized in that the base steel sheet has a composition that further includes at least one kind selected from 0.2 percent or less of Ti, 0.2 percent or less of Nb and 0.2 percent or less of V, by mass percent.

8. A method of manufacturing a galvannealed steel sheet excellent in the coating adhesion characterized in that a base steel sheet that contains, by mass percent, 0.25 percent or less of C, 0.03 to 2.0 percent of Si and 0.005 to 0.07 percent of P and has a composition satisfying the following equation (1) is heat treated so that Si in the steel is not selectively

surface oxidized, followed by cooling to a coating temperature in an atmosphere having an oxygen concentration of 0.005 volume percent or less, further followed by dipping the base steel sheet in a molten zinc coating bath to form a coating layer, still further followed by heating at a temperature rise speed of 20 degree centigrade/s or more to a temperature range of 460 to 600 degree centigrade and holding in the heating temperature range to apply a galvannealing process of the coating layer.

Note

$$[C] + [P] \leq [Si] \quad (1)$$

Here, [C], [P] and [Si], respectively, mean contents (mass percent) of C, P and Si in the base steel sheet.

9. The method of manufacturing a galvannealed steel sheet excellent in the coating adhesion according to claim 8 characterized in that the base steel sheet has a composition that further includes, by mass percent, 5 percent or less of Mn, 0.01 percent or less of S and 0.08 percent or less of Al.

10. The method of manufacturing a galvannealed steel sheet excellent in the coating adhesion according to claim 8 or 9 characterized in that the base steel sheet has a composition that further includes at least one kind selected from 0.2 percent or less of Ti, 0.2 percent or less of Nb and 0.2 percent or less of V, by mass percent and the temperature rise speed and a content of Si in the base steel sheet satisfy

the following equation (2).

Note

$$ST \geq 3.25 / [Si] \quad (2)$$

Here, in the equation, ST designates a temperature rise speed (degree centigrade/s) and [Si] designates a content (mass percent) of Si in the steel sheet.